AUTOMATION IN CONSTRUCTION INDUSTRY

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Abstract: In India, the construction industry is one of the largest industrial sectors. The construction industry plays to enhance the overall national economy of the India, the complaints of poor construction quality is major problem in the India construction industry. For successful quality work, such as lack of skilled workers, poorly installed equipment, poor plans, etc. among this in an increase in the real cost of construction & labour. The construction industry is labour intensive and construction work is conducted in risky and dangerous situations. The importance of construction automation has grown rapidly in developed countries. In developing countries like India, the construction industries need automation technologies such as new machineries, electronic devices etc. The infrastructure project requires more numbers of skilled labour, good quality of work, increases productivity etc. Studying recent application and projects for using robots and automation in the construction industry. The qualitative study has been carried out. From this qualitative study some obstacles in implementing automation are discussed in this paper.

Keywords: Automation, Automation at site level, Automation at industrial level, Obstacles

I. INTRODUCTION

Until very recently, the construction industry was one of the most unfamiliar to research & development fields for the robotics and automation community, despite the fact that this industry is one of the oldest and represents the largest economic sectors. Today the Indian population is getting educated, thus labour intensive jobs have very few takers and the trend will worsen with the disparity in the income decreasing with the future generation opting for higher education. Nevertheless, some of Nowadays construction processes have changed little. The old days pulleys are substituted by cranes. At times construction work is conducted under dangerous condition and situation, thus there is need for robotics to optimize equipment operation improve safety and quality of work. Automation can be done in uniform brick laying, plastering of uniform thickness of ceilings, interior & exterior walls. Automation can provide reduced labour dependability higher output and increased productivity, less variability, reduced human errors, greater control & consistency, safe working environment, flexibility etc. Construction phase is one of the important aspects of civil engineering structures. The success of a project depends on how well the
construction phase is carried out. Efficient and economical construction is particularly important because of the increasing complexity of structures being built, the availability of improved materials and construction equipment. Typically in manufacturing field, robots are stationary and product moves along the assembly line.

II. DEFINITIONS

- “Automation is the technique, method, or system of operating or controlling a process by highly automatic means, as by electronic devices, use of control systems and information technologies, reducing human intervention to a minimum.”
- “Automation can be defined as appropriate use of machines, electronic devices and computer software for the construction work to increase the productivity of construction project, reduces the duration and laborious work, and increases the construction safety.”
- “Construction automation has been described as the use of mechanical and electronic means in construction to achieve automatic operation or control to reduce potential exposure, time or effort while maintaining or improving quality.”

III. ADVANTAGES & DISADVANTAGES

The project success from the project management’s viewpoint is achieved when the project is completed with the lowest possible cost, the highest quality, no accidents etc. In other words, success means bringing each of the project performance indicator (PPI) such as cost, schedule, quality, safety, labour, productivity, material consumption or waste, etc. to an optimum values.

The advantages of automation:
- Higher safety for both worker and public through developing and deploying machines for dangerous jobs.
- Uniform quality with higher accuracy than that provided by skilled worker.
- Improving work environment as conventional manual work is reduced to minimum, so the workers are relieved from uncomfortable work positions.
- Eliminating complains about noise and dust concerning works such as removal, cleaning or preparation of surfaces.
- Increasing productivity and work efficiency with reduced costs.

Disadvantages of automation:
- Unemployment at the cost of modernization
- Leads to drain from the country
- Requires a high capital cost for setting up and maintenance
- Skilled and expert handlers or workers are required due to the need of high technical knowledge to operate the machines
- Untrained workers cannot be employed which increase the initial cost of project
- Trained labours are not available easily and trained labours charges higher than untrained labours

IV. STATE OF THE ART IN CONSTRUCTION AUTOMATION

The main research activities of the RAC in the past decade were divided accordingly to applications into two large groups: civil infrastructure and house building. Typical civil
infrastructure robot applications are the automation of road, tunnel and bridge construction, earthwork, etc. In the group of house construction, main applications include building skeleton erection and assembly, concrete compaction, interior finishing, etc. Classification according to applications is consistent with other possible classifications, which divide RAC R&D activities according to the development of new equipment and processes or the adaptation of existing machinery to transform them into robotic system. Automation is classified into various categories but I classify into two categories they are:

1. Automation at site level and
2. Automation at industrial level

A. Automation at site level

The challenges of developing robots for construction jobsite are much greater than those of most factories. First the products of construction are much more complex and ill structured. Second, in contrast to the repetitive products that flow down production lines, the designs of the construction product and the process to build it are individually adapted in each case. While the manufacturing process is highly repetitive once production starts, that in construction is always changing. The physical environment of construction is often much more hostile to machines as well as people, so machine design must be sturdy and robust accounting for extremes of weather, dust and unexpected forces. Given the difficult and complex environment of construction, it is remarkable that robots and automated machines are already performing routine tasks on some jobsites. The first construction robots have either been derived by adding sensors and computer-based controls to existing construction equipment (e.g., to control the cutting edges or screeds on various types of earthmoving and paving equipment, robotic tower crane etc.), by adapting the comparatively rigid factory-type robots to construction (e.g., for spraying fireproofing material or painting), or by developing hybrids of the two (e.g., robot arms mounted on tunnel machines). While the sophistication of their mechanisms and sensors has often been quite high, these robots have had only the most basic forms of on board "intelligence."

Fig 1: OSYRIS project sensor-based compactor
Source: Trends in Robotics and Automation in Construction

Fig 2: CSIRO's dragline project
Source: Trends in Robotics and Automation in Construction

Fig. 3: the Automated excavator of the University of Sidney
Source: Trends in Robotics and Automation in Construction

Fig 4: ROMA climbing inspection robot
Source: Trends in Robotics and Automation in Construction
B. Automation at industrial level

The development in the field of construction is being predominantly characterized by increasing shortage of skilled labour. This shortage will have to be compensated for by an increase in the level of prefabrication to be achieved in the manufacture of pre-cast concrete, wooden, steel frame and brick wall building elements. As an example I describe here the increasing market demand for pre-cast concrete roof, ceiling elements and pre-cast concrete wall elements to pre-cast concrete columns and beams as well as advanced precut systems for wooden elements, steel element factories and automated brick wall facilities and on site systems of robotics and automation.

Another substantial advantage in favor of the pre-cast concrete elements consists in the job efficiency of the workforce. As the building site personnel is to a far lesser extent concerned with somewhat more complicated tasks, such as, for example, moulding, insertion of reinforcement steel, etc. than is normally the case with regular construction workers, job efficiency at the plant level reaches an optimum that cannot possibly be arrived at on a building site. Costs of transportation are approximately the same both for the prefabricated elements and for corresponding quantities of site mixed concrete.

V. WHY IT’S NOT ADOPTED BY ALL CONSTRUCTION INDUSTRY

Infrastructure construction is growing very largely in India. The construction industry needs automation techniques to perform the risky and dangerous work for good quality of work, increase productivity, reduce duration etc. Automation has been indicator of technological and developmental progress of infrastructure project. The obstacles while implementing automation technologies in Indian construction industry are as follows:

**High cost:** Cost would be a major factor in deciding on whether take or not to take on a technology. Cost consideration should include not only the purchasing cost, but also the maintaining the automation technologies and see that it can improve overall efficiency and productivity.

**Limited Resource Available to Small and Medium Size Firms:** The funding of small and medium size firm is sufficient to purchase the automation technology according to their turnover. The small and medium size firms are unable to purchase new technologies because of fund available is very less as compared to big firms.

**Automation Technologies are Expensive to Update and Maintain:** These techniques are so expensive to update and maintain the progress of automation techniques. There maintenance cost is also high so that nobody wants to invest in such expensive technologies, especially the smaller companies.
Low Technological Knowledge to Workers: The techniques are not easily accepted by workers due to they have no knowledge about automation. Nowadays, there is need to training of workers to operate these techniques in proper manner.

VI. CONCLUSION

Due to the high complexity of the construction process and the advance technological development a long-term preparation is necessary to adopt it to advanced construction methods. Architects, engineers and all other participants of the construction process have to be integrated in this adaptation process. The short- and long-term development of automation will take place step-by-step and will be oriented to the respective application and requirements. Not only in stationary industry, but also on-site the computer-supported building production of the future could be monitored by the human being in a control room, whereby a qualified building worker can simultaneously control several building machines. All that is needed is an effective communications system between the control officer and autonomous building machines. The performance of robotic technology is increasing rapidly and we can support its advancement by designing, engineering, managing the construction processes and products in a robot oriented way. The importance of implementing automation technologies is the need of today’s infrastructure project and construction firms to increase the productivity and good quality of work. Both small and medium size firm are the need of automation technologies to implement in different sectors such as design, planning, on site construction etc.

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